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Resonant X-ray Investigation of Ni Oxide Thin Films

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Introduction: We have studied by resonant x-ray diffraction NdNiO₃ thin films grown on different substrates. It is found that resonant features vs temperature can be related to the respective resistivity of each sample.

Methods and Materials: RNiO₃ is a prototype bandwidth-controlled perovskite exhibiting a thermally driven metal-insulator transition. We have studied at the Ni K-edge NdNiO₃ thin films on SrTiO₃ and LaAlO₃ substrates for which the in-plane lattice parameter is expanded and constrained respectively. Resonant diffraction enables to study electronic orderings, for example charge ordering on a specific set of atoms, here the Ni. We then study how the resistivity is related to the structural and electronic phase transition involving the Ni atoms.

Results: Depending on the substrate, the resistivity shows either a steep increase as the temperature decreases or a dramatic increase around the phase transition temperature. We observe effectively two different behaviours of the resonant spectra for each film. A resonant anomaly is observed for the NdNiO₃ on LAO and might be understood as a charge ordering of the Ni ions, whereas the film on STO doesn't show neither this resonant anomaly nor a phase transition. Further investigations will be pursued with substrates that expand or constrain even more the films.